

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

| | | |
|---|--|---|
| Applicant's or agent's file reference 19916-38PC | FOR FURTHER ACTION | see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. |
| International application No. PCT/US01/05164 | International filing date (<i>day/month/year</i>) 16 February 2001 (16.02.2001) | (Earliest) Priority Date (<i>day/month/year</i>) 16 February 2000 (16.02.2000) |
| Applicant QUANTUM DOT CORPORATION | | |

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 3 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the Report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

2. ☐ Certain claims were found unsearchable (See Box I).

3. ☐ Unity of invention is lacking (See Box II).

4. With regard to the **title**,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.



None of the figures

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/0164

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : G01N 33/53

US CL : 435/7.1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 435/7.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
MEDLINE, BIOSIS, CAPLUS, WPIDS**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| A | Mahtab et al., Preferential Adsorption of a "Kinked" DNA to a Neutral Curved Surface: Comparisons to and Implications for Nonspecific DNA-Protein Interactions. J. Am. Chem. Soc., 1996, Vol. 118, pp. 7028-7032. | 1-39 |
| A | Empedocles et al., Photoluminescence from Single Semiconductor Nanostructures. Adv. Mater. 1999. Vol. 11, No. 15, pp. 1243-1256. | 1-39 |
| Y, P | Empedocles et al., Detection and Spectroscopy of Single CdSe Nanocrystallite Quantum dots. Dissertation Abstracts International. June 2000. Vol. 60, No. 12.p. 6163-B. | 1-39 |
| A, P | Empedocles et al., Photoluminescence from Single Semiconductor Nanostructures. Charact. Nanophase Mater. 2000, pp. 261-287. Edited by Wang, Zhong Lin. | 1-39 |
| A | Empedocles et al., Spectral Diffusion of Ultra-Narrow Fluorescence Spectra in Single Quantum Dots. Matter. Res. Soc. Symp. Proc., 1997, Vol. 452, pp. 335-340. | 1-39 |
| A | Empedocles et al., Influence of Spectral Diffusion on the Line Shapes of Single CdSe Nanocrystallite Quantum Dots. J. Phys. Chem., B 1999. Vol. 103, pp. 1826-2830. | 1-39 |
| A | Empedocles et al., Photoluminescence Spectroscopy of Single CdSe Nanocrystallite Quantum Dots. Physical Review Letters. 28 October 1996, Vol. 77, No. 18, pp. 3873-3876. | 1-39 |

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

| | | |
|---|-----|--|
| * Special categories of cited documents: | "T" | later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| "A" document defining the general state of the art which is not considered to be of particular relevance | "X" | document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| "E" earlier application or patent published on or after the international filing date | "Y" | document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" | document member of the same patent family |
| "O" document referring to an oral disclosure, use, exhibition or other means | | |
| "P" document published prior to the international filing date but later than the priority date claimed | | |

Date of the actual completion of the international search

Date of mailing of the international search report

12 JUN 2001

Name and mailing address of the ISA/US

Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703)305-3230

Authorized officer

Bao-Thuy L. Nguyen

Telephone No. (703) 308-0496

NOTES TO FORM PCT/ISA/220 (continued)

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under Article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

The statement should be brief, it should not exceed 500 words if in English or if translated into English.

It should not be confounded with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It should not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

In what language ?

The amendments must be made in the language in which the international application is published. The letter and any statement accompanying the amendments must be in the same language as the international application if that language is English or French; otherwise, it must be in English or French, at the choice of the applicant.

Consequence if a demand for international preliminary examination has already been filed ?

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase ?

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 01/0164

C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|---|-----------------------|
| A | Empedocles et al., Quantum-Confined Stark Effect in Single CdSe Nanocrystallite Quantum Dots. <i>Science</i> . 19 December 1997, Vol. 287, pp. 2114-2117. | 1-39 |
| Y, P | Leatherdale et al., Photoconductivity in CdSe Quantum Dot Solids. <i>Physical Review B: Condens. Matter Mater. Phys.</i> 15 July 2000, Vol. 62, No. 4, pp. 2669-2680. | 1-39 |
| Y, P | Leatherdale et al., Charge Generation and Transport in CdSe Semiconductor Quantum Dot Solids. <i>Mat. Res. Soc. Symp. Proc.</i> 2000, Vol. 571, pp. 191-196. | 1-39 |
| A | Empedocles et al., Spectroscopy of Single CdSe Nanocrystallites. <i>Acc. Chem. Res.</i> , 1999, Vol. 32, pp. 389-396. | 1-39 |
| Y, P | Mattoussi et al., Self-Assembly of CdSe-ZnS Quantum Dot Bioconjugates Using an Engineered Recombinant Protein. <i>J. Am. Chem. Soc.</i> , 2000, Vol. 122, pp. 12142-12150. | 1-39 |
| Y, P | Neuhauser et al., Correlation between Fluorescence Intermittency and Spectral Diffusion in Single Semiconductor Quantum Dots. <i>Physical Review Letters</i> . 09 October 2000, Vol. 85, No. 15, pp. 3301-3304. | 1-39 |
| A | Shimizu et al., Stark Spectroscopy Investigation of Spectral Diffusion in Single CdSe Quantum Dots. <i>Electrochemical Society Proceedings</i> . 1999, Vol. 98, No. 19, pp. 280-285. | 1-39 |

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| | | |
|---|---|---|
| Applicant's or agent's file reference 19916-38PC | <div style="display: flex; justify-content: space-between;"> <div> FOR FURTHER ACTION </div> <div> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) </div> </div> | |
| International application No. PCT/US01/05164 | International filing date (day/month/year) 16 February 2001 (16.02.2001) | Priority date (day/month/year) 16 February 2000 (16.02.2000) |
| International Patent Classification (IPC) or national classification and IPC IPC(7): G01N 33/533 and US Cl.: 435/7.1 | | |
| Applicant QUANTUM DOT CORPORATION | | |
| <p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of <u>4</u> sheets, including this cover sheet.</p> <p><input type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of <u>0</u> sheets.</p> <p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of report with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input checked="" type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application | | |
| Date of submission of the demand 22 August 2001 (22.08.2001) | Date of completion of this report 07 November 2001 (07.11.2001) | |
| Name and mailing address of the IPEA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703)305-3230 | Authorized officer Bao-Thuy L. Nguyen Telephone No. (703) 308-0196 | |

Form PCT/IPEA/409 (cover sheet)(July 1998)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US01/05164

I. Basis of the report

1. With regard to the elements of the international application:*

- ☒ the international application as originally filed.
- ☒ the description:
pages 1-58 _____ as originally filed
pages NONE _____, filed with the demand
pages NONE _____, filed with the letter of _____.
- ☒ the claims:
pages 59-64 _____, as originally filed
pages NONE _____, as amended (together with any statement) under Article 19
pages NONE _____, filed with the demand
pages NONE _____, filed with the letter of _____.
- ☒ the drawings:
pages 1-12 _____, as originally filed
pages NONE _____, filed with the demand
pages NONE _____, filed with the letter of _____.
- ☐ the sequence listing part of the description:
pages NONE _____, as originally filed
pages NONE _____, filed with the demand
pages NONE _____, filed with the letter of _____.

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in printed form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages NONE
- ☐ the claims, Nos. NONE
- ☐ the drawings, sheets/fig NONE

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/US01/05164**V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. STATEMENT**

| | | |
|-------------------------------|--------------------|-----|
| Novelty (N) | Claims <u>1-39</u> | YES |
| | Claims <u>NONE</u> | NO |
| Inventive Step (IS) | Claims <u>1-39</u> | YES |
| | Claims <u>NONE</u> | NO |
| Industrial Applicability (IA) | Claims <u>1-39</u> | YES |
| | Claims <u>NONE</u> | NO |

2. CITATIONS AND EXPLANATIONS

Claims 1-39 meet the criteria set out in PCT Article 33(2)-(4), because the prior art does not teach or fairly suggest a method of detecting a target species using two different single quantum dots as label.

----- NEW CITATIONS -----

Chan et al., Quantum Dot Bioconjugates for Ultrasensitive Nonisotopic Detection. Science. Vol. 281. 1998. Pages 2016-2018.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/US01/05164

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

| Application No Patent No. | Publication Date (day/month/year) | Filing Date (day/month/year) | Priority date (valid claim) (day/month/year) |
|------------------------------|--------------------------------------|-----------------------------------|---|
| 6,207,392 B1 | 27 March 2001 (27.03.2001) | 01 March 1999 (01.03.1999) | None |
| 6,114,038 A | 05 September 2000 (05.09.2000) | 11 August 1999 (11.08.1999) | None |
| 6,306,610 B1 | 23 October 2001 (23.10.2001) | 17 September 1999 (17.09.1999) | None |
| 6,287,768 B1 | 11 September 2001 (11.09.2001) | 03 March 2000 (03.03.2000) | None |
| 6,274,323 B1 | 14 August 2001 (14.08.2001) | 05 May 2000 (05.05.2000) | None |

2. Non-written disclosures (Rule 70.9)

| <u>Kind of non-written disclosure</u> | <u>Date of non-written disclosure</u> (day/month/year) | <u>Date of written disclosure referring to</u> <u>non-written disclosure</u> (day/month/year) |
|---------------------------------------|---|---|
|---------------------------------------|---|---|